DOCUMENT RESUME

ED 059 070 SE 013 239

AUTHOR Riggs, Roderick D.
TITLE A Study of Junior College Level Physics in German Speaking Europe.
INSTITUTION Jackson Community Coll., Mich.
PUB DATE 71
NOTE 31p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS College Science; *Comparative Education; Curriculum; *Instruction; International Education; *Junior Colleges; *Physics; Student Characteristics; Student Evaluation
IDENTIFIERS Austria; Switzerland; United States; West Germany

ABSTRACT

The purpose of this study was to analyze physics instruction in West Germany, Austria, and German-speaking Switzerland at levels comparable to junior colleges in the United States, and to compare this with the physics instruction offered at Jackson Community College (Jackson, Michigan). The investigator spent four months interviewing faculty and students in the various types of high schools, engineering colleges, and universities in the three countries. His findings are reported under three headings: Students, Curriculum, and Evaluation. The first section summarizes the distribution of sex, age and socioeconomic status of the students, average class loads, admission and graduation ratios, and the sizes of the various institutions. The second section compares the level, rigidity and objectives of the physics curricula, the methods of conducting classes, and the associated mathematical requirements. The third section covers the examination requirements and procedures for admission and graduation at the different levels. A large part of the paper is then devoted to an interpretation of these findings and a comparison with physics education in junior colleges in the United States. (MM)

ED 059070

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

A STUDY OF JUNIOR COLLEGE LEVEL PHYSICS IN GERMAN SPEAKING EUROPE

by

Roderick D. Riggs
Jackson Community College
Jackson, Michigan 49201

The purpose of the study was to analyze physics instruction in the German speaking countries of West Germany, Austria, and German speaking Switzerland at educational institutions that offered instruction at a level comparable to that found in the junior colleges of the United States. This analysis of German physics teaching was then compared to the physics instruction offered at Jackson Community College. Thus, the Jackson Community College physics program served as the basis of reference for the study. It was felt that by making such a comparison there would be information, insight, techniques, programs, and other possible facets of physics instruction in German speaking Europe that could be of value to Jackson Community College.

It must be recognized that there is no existing educational institution that is the exact equivalent of the United States junior college. Therefore, it was necessary to investigate physics instruction at a variety of educational institutions that served students in the approximate age range as found in the junior college. Also, the combination of objectives from these various European institutions was

SE 013 239

TABLE 1.--Components Which Contributed to the Study

Country	Type of Institution	Number of Institutions Visited	Number of Staff Interviewed	Number of Students Interviewed
West Germany[a]	Gymnasium	5	16	12
	University	3	10	5
	Pädagogische Hochschule	1	3	3
	Polytechnikum	1	3	2
	Kolleg	4	9	11
	Berufsschule	1	2	1
	Education Ministry	2	4	0
Austria	Gymnasium	6	15	9
	University	2	3	3
	Höhere Lehranstalt	2	6	4
	Education Ministry	3	6	0
Switzerland	Gymnasium	2	5	5
	University	2	4	4
	Technikum	1	3	2
	Pro-Helvetia	1	3	0

[a]It should be noted that educational institutions visited in West Germany all were in the state of Bavaria. There was some concern about whether Bavarian education was typical of all West Germany. The federal officials in Bonn confirmed that the educational structure and program in Bavaria were quite typical of the entire country.

compared to that found at the junior college level. To establish a basis for comparison, a spectrum of institutions was studied. Included were general universities and technical universities. Also visited were the various types of Gymnasien found in the three countries, the engineering colleges, and special institutions that provided high school programs for adults. The latter were the Kollege of West Germany.

The time period from January 21, 1969, to May 15, 1969, was spent visiting educational institutions, ministries of education, and related enterprises in the three countries of West Germany, Austria, and German speaking Switzerland. The geographical locations of the cities in the three countries visited were within a circle of 150 miles radius with Munich, West Germany, at the center. The only city outside this circle was Vienna, Austria, which was located approximately 250 miles east of Munich. Table I indicates the various components which contributed to the study as to institutional type and location.

The procedure for gathering the information desired usually included a series of visitations which provided an opportunity to talk to students, faculty, administrators, and to spend time attending physics classes and laboratories. To formalize the interview process, a questionnaire was developed which included the following major topic headings:

A. Basic data on institution as to size, type, location, etc.

B. Interviewees

C. General descriptive data on students and school calendar

D. Institutional objectives

E. Relationship of school to environment

F. Teaching staff

G. Student input

H. Completion data

I. Curriculum

J. Pedagogical techniques

K. Evaluation

L. Mathematics related to physics programs

M. Key physical principles - when and where introduced

N. Look to the future

O. General comments based upon observations

This same questionnaire was completed for Jackson Community College and thus served as the basis for comparisons. The above questionnaire items were organized under three major topic headings: Students, Curriculum, and Evaluation with data, findings, and conclusions arranged in that order. Not all of the data collected were utilized in this particular study.

Space does not permit the inclusion of the data under the categories of Students, Curriculum, and Evaluation for each institutional type in each of the countries; but I will include the criteria for comparison of the level of

sophistication of physics programs under Curriculum. These were topics often covered in the first-year physics courses at United States colleges and universities, but not usually covered in the typical United States high school physics course. The topics were:

1. Kinematics and dynamics using the calculus
2. Maxwell's distribution and the kinetic theory of gases
3. Mathematical treatment of the magnetic effects of current flow
4. Fresnel and Fraunhofer diffraction
5. Special theory of relativity
6. Introduction to quantum mechanics

Summary of the Findings

Students

There were many similarities among the populations of the Gymnasien of the three European countries. Male students outnumbered females by more than two to one. The majority of the European Gymnasium students came from middle to upper-middle class families. Students attended classes in the mornings and early afternoon hours over a six-day week, with weekly class loads of from thirty to forty contact hours. Over 90 per cent of all students who applied to the various Gymnasien were admitted. Most Gymnasium students planned to continue their educations at universities or Hochschulen. Approximately 30 to 40 per cent of all students who enrolled in Gymnasien successfully completed. Those who completed constituted only 6 to 9 per cent of the total eighteen to twenty-year-old age group.

The European universities and Technische Hochschulen studied were small by United States standards,

ranging in size from 5,000 to 10,000 students. The only exception was Munich University with 25,000 students. It was the largest university in West Germany, Austria, or Switzerland. Approximately 6 per cent of the total university student populations were enrolled in the beginning physics sequences. Twenty to 25 per cent of the total Technische Hochschule student bodies were enrolled in the beginning physics sequences. All Gymnasium graduates were eligible to enroll in any university of Hochschule. The socio-economic backgrounds of the university and Hochschule students were similar to the Gymnasium students, with very few students coming from working class and lower-middle class families. Approximately 70 per cent of all students enrolled in beginning physics sequences successfully completed them. University and Hochschule students carried weekly class loads of from twenty to thirty contact hours.

Virtually all of the students at the engineering colleges were male, and all took some physics as a part of their various technical curricula. Students carried class loads of from thirty to forty-five contact hours spread over a six-day week. Only 50 per cent of all students who applied were admitted. In West Germany and Switzerland, a student must have completed some secondary education plus some work experience or apprenticeship to apply for admission. Applying students ranged from

eighteen to twenty-four years of age. Students who applied to the Austrian Höhere Lehranstalten were admitted after a total of eight years of elementary and secondary education. Thus, they were admitted at fourteen to sixteen years of age. Most of the students at all of the engineering colleges came from working class and lower-middle class families. Approximately 60 per cent of all students who were enrolled successfully completed their respective programs.

The Kollege were found only in West Germany and enrolled students who were older than the Gymnasium students in comparable programs. All Kolleg students took physics as a part of their respective curricula. Male students outnumbered female students by more than three to one. Students were enrolled for twenty contact hours per week in the evening programs and up to thirty-five contact hours in the day programs. The evening Kollege had three-year programs and paralleled the last three years of the Gymnasium. The day Kollege compressed the three-year Gymnasium programs into two and one-half years. Only 10 to 30 per cent of the students who applied to the Kollege were admitted. Over half of the students were interested in pursuing the vocations of engineering and teaching. Approximately 50 per cent of the students who began the Kollege completed the Abitur successfully.

Most of the physics students at Jackson Community College were between the ages of eighteen and twenty-one. Men outnumbered women three to one. Students who were enrolled in beginning physics sequences had class loads averaging fifteen contact hours per week spread over a five-day week. Most of the students came from lower-middle to middle class families. Over 70 per cent of all students enrolled in physics classes completed them successfully.

Curriculum

There were only two basic types of physics curricula for all of the types of Gymnasien in West Germany, Austria, and Switzerland. There was the mathematics and science curriculum; and there was a common physics curriculum for the modern language, classical language, economics, and fine arts Gymnasien. Regardless of curriculum, all students took physics for several years. The mathematics and science students had physics for a greater number of class meetings per week, for more years than the students at the other Gymnasien, and pursued topics to greater depth. All of the Gymnasium students were required to take mathematics through calculus. The mathematics and science students had calculus through transcendental functions while the other Gymnasium students had calculus only through algebraic functions. None of the students were exposed to differential equations. The Gymnasium

physics classes were small, usually under thirty students but conducted as lecture-demonstrations. Most of the Gymnasien followed fairly rigid course outlines with little room for flexibility on the part of the instructor. There was a good deal of interchange between students and teaching staffs in the classroom. Few of the Gymnasien had libraries, and those which did rarely had physics students using them. The West German Kollege offered the same basic curricula as did the West German Gymnasien.

The universities and Technische Hochschulen started their physics courses below the level of the final Gymnasium physics but quickly accelerated to a more sophisticated level. The university and Technische Hochschule physics usually required calculus and differential equations as pre-requisites. This was accomplished in some cases by delaying the start of the beginning physics sequence until the student's second or third semester. All of the beginning physics lecture sequences had associated laboratories. When students at the universities began the physics lecture courses during their first semester, the beginning of the laboratory was often delayed at least one semester. The Technische Hochschulen did not allow students to begin their physics until the second or third semester and then ran the laboratories in phase with the lecture portion of the course. The

demonstrations performed in the lecture classes at the universities and Technische Hochschulen were very dramatic and required vast quantities of time and effort to set up. These demonstrations utilized great quantities of highly specialized equipment. Lecture classes were large and very formally conducted. Textbooks were rarely used, and the lecturing professor's notes constituted the basic written material for the course. Physics laboratories had enrollments of under twenty students and were conducted by junior professors and graduate students.

There were many similarities among all of the engineering colleges in the three European countries, especially between the West German Polytechnikum and the Swiss Technikum. The Polytechnikum and Technikum served the same age group, had the same entrance requirements, offered the same technical curricula, and required the same amount and level of physics in these curricula. The Austrian Höhere Lehranstalt was different in terms of the younger age group it served, its five-year rather than three-year programs, its different entrance requirements, its granting of the Mature, and the fact that its graduates did not receive an engineering title upon graduation. The Höhere Lehranstalten were similar to their West German and Swiss counterparts in terms of the type of engineering programs offered, the amount of physics

required in corresponding curricula, and the sophistication of the physics taught in various engineering curricula. The sophistication of the physics taught approximated that found in the mathematics and science Gymnasien of all three countries. The mathematics encountered by the students at the engineering colleges usually included some differential equations; but this was taken after completing the physics portion of their total curriculum, so it provided little help. The physics was taught in lecture classes that did not exceed forty-five students. Considerable use of demonstrations, films, closed-circuit television, and computers was found at all of the engineering colleges. All of the physics programs had associated laboratories. The application of physical principles to the various engineering specialties was an important theme throughout the various engineering specialties was an important theme throughout the various physics sequences. While libraries existed in all of the engineering colleges, physics students did not utilize them to any great extent but rather used lecture notes, textbooks, and laboratory materials to fulfill their class obligations.

There were four major divisions within the physics offerings at Jackson Community College. The divisions were the general education courses, college-parallel courses, the terminal-technical course, and the

continuing education courses. A student elected the respective course depending upon his vocational objectives and whether or not the student possessed the mathematics background that the course required for his enrollment. The sophistication of the beginning physics sequences varied significantly among the general education, college parallel, and terminal-technical courses. Again, this level of sophistication was more dependent upon the mathematical background of the students admitted than whether or not the student had had any physics previously. These mathematics pre-requisites varied from one year of high school algebra for one of the general education courses to one year of calculus for the University Physics sequence. All of the beginning physics sequences had associated laboratories. Lecture classes varied in size from ten to thirty-five students. There was great emphasis placed upon class recitation, problem solving, use of the textbook, and audio-visual materials in the classes. Demonstrations were performed infrequently. Physical facilities were excellent, and the physics department possessed a great quantity of demonstration and laboratory equipment. Library facilities were good but rarely used by beginning physics students.

Evaluation

The Gymnasien in the three European countries required written and oral examinations from all prospective

students. In West Germany and Austria, these examinations were in the areas of mathematics and German. In German speaking Switzerland, the written and oral examinations were in mathematics, German, and French. As indicated in Chapter IV, over 90 per cent of all students who applied were admitted. All of the physics programs at the various Gymnasien in the three countries had periodic examinations and were assigned grades. These grades were unofficial in the sense that graduation from the Gymnasium was recognized only after the final comprehensive examination was successfully completed. This comprehensive examination or maturity examination was called the Abitur, the Mature, or the Matur in West Germany, Austria, and Switzerland respectively. Although all West German Gymnasium students were required to take physics, not all were required to be examined in physics in their final examinations. Only the West German mathematics and science Gymnasium students were required to be examined in physics. The students at the other types of Gymnasien could elect physics as one of their optional examination topics, but very few did. Physics was an optional Mature examination topic in Austria. All Swiss Gymnasium students were required to take the written test in physics and could elect the oral part of the physics examination if they desired. Those West German and Austrian students who did not write a comprehensive examination in physics

still attended Gymnasien that had systems of grading that required semester and annual grades, and a student had to maintain satisfactory progress in all subjects, including physics, in order to be promoted to the next class and eventually become eligible to graduate. The West German Abitur required written tests in four subjects plus oral tests in three more. The written subjects were German, mathematics, and two more subjects consistent with the student's course of study. The Austrian Mature had written and oral tests in seven subject areas. These areas were German, mathematics, and five additional subjects depending upon the particular course of study. The Swiss Matur tested all students in eleven different subject areas. All students were tested in the areas of German, French, history, geography, mathematics, physics, chemistry, biology, free-hand drawing, plus two additional topic areas dependent upon curriculum choice. The Matur examined students orally, in writing, or a combination of both according to a complicated pattern which was a function of the student's curriculum and student choice of test subjects.

The West German Kollege followed the same examination procedures in its physics courses and in the Abitur as the West German Gymnasien. There were some variations in admission testing since the students were admitted assuming more advanced educational backgrounds. Instead

of testing in only German and mathematics, the prospective Kolleg student was tested in the areas of German, mathematics, and English.

The major requirement for admission to a university or Hochschule was possession of the Abitur, the Mature, or the Matur. Admission to specific beginning physics sequences was independent of previous success in physics or mathematics. Very few of the universities and Technische Hochschulen had any evaluation conducted during or at the conclusion of their beginning physics sequences. The institutions relied on comprehensive examinations at the end of two to three years called Vor-Diplom examinations which included some physics as a part of the total test battery. The Vor-Diplom was an intermediate examination which was followed by the Diplom examination after an additional three to four years of university or Technische Hochschule study. These institutions were committed to the concept of comprehensive testing as the sole criterion for determining student progress.

The engineering colleges operated on a significantly different basis from the Gymnasien, universities, and Technische Hochschulen. The West German Polytechnikum had entrance examinations in the areas of physics, mathematics, mechanical drawing, English, and German. The Austrian Höhere Lehranstalten tested prospective students in the areas of mathematics, German, and general intelligence. The Swiss Technikum tested their prospective

students in the areas of German, mathematics, and technical drafting. All of the institutions had periodic examinations, and grades were assigned for the physics courses required of all students. These grades were used for determining general progress but did not constitute the criteria for completion of the total programs. In all cases successful completion was determined by comprehensive examination. In the West German Polytechnikum, there was a major intermediate comprehensive examination administered at the end of the student's third semester. The final comprehensive examination, called the Ingenieurprüfung, was administered at the end of the sixth semester. Both examinations contained physics as one of the examination topics. The situation was very similar at the Swiss Technikum. The intermediate comprehensive examinations came at the end of the fourth semester, and the final battery was administered at the conclusion of the student's sixth semester. The Austrian Höhere Lehranstalten followed a pattern that closely paralleled the Gymnasien of the three European countries. There were no intermediate comprehensive examinations, just individual course grades to determine satisfactory progress. At the conclusion of the final year, all students wrote the same Mature that was written by Austrian Gymnasium students. The Höhere Lehranstalt students took oral and written tests in mathematics, German, English,

descriptive geometry, plus three more elective subjects. Physics was one of these subjects and was often chosen by Höhere Lehranstalt students.

There were no entrance examinations at Jackson Community College. A test battery was administered to all entering freshmen which was used by the counseling staff to assist the students in course and vocational selection. It tested students in the areas of natural science, mathematics, English, and social science. In all physics courses and sequences, there were a variety of evaluation processes. Periodic examinations, laboratory reports, problem sets, and short quizzes were combined to yield a final semester grade for each student. This grade became a part of the student's permanent record. There were no comprehensive examinations comparable to those found in all European educational institutions. The credit hour system was the sole basis for determining student progress in a course of study.

Conclusions

Probably the most significant implication of this total study was that it provided a comparison of physics instruction in corresponding European educational institutions, a comparison that had not as yet appeared in any of the German or English language literature. In fact, there was very little descriptive writing about any

of the instruction in the types of institutions studied. Jackson Community College served only as a familiar and convenient reference point to anchor the entire study.

There was a great deal of similarity among comparable institutions in the three European countries, more than could be attributed to the common language utilized throughout. With some notable exceptions, the various institutions served the same socio-economic classes with the same curricula and did this in the same general physical settings with approximately the same dogmatic attitudes from the teaching staffs and the rigid bureaucracy found in the state and federal ministries of education. The notable exceptions to the above generalizations were cited previously and included the degree of flexibility found in some Swiss institutions with their less rigid teaching staffs. Another exception to this rigid pattern was found in the engineering colleges of the three European countries. Their pragmatism was in sharp contrast to the authoritarian attitude of the other institutions and more closely paralleled the general situation observed at Jackson Community College.

Students

One of the most significant conclusions related to the fact that all Gymnasium students took several years of physics and that physics occupied a greater part of the student programs than either biology or chemistry. This

was true in all three European countries. As expected, all students at the engineering colleges and Technische Hochschulen took physics, while only some of the general university students found physics in their curricula. In that sense the latter students were similar to the students at Jackson Community College.

It was noted that the Gymnasien in all three European countries were fairly exclusive institutions since only some 20 per cent of the potential entering students found themselves enrolling. The fact that only 6 to 8 per cent of that total age group successfully completed the Gymnasien meant that a very small percentage of the youth was qualified to continue its education at the universities. This was in sharp contrast to the percentage of students who graduated from high school and were eligible to enroll at Jackson Community College. A percentage many times in excess of 6 to 8 per cent of the age group graduated from Jackson County high schools and was eligible to enroll at Jackson Community College with its "open-door" policy.

It has been pointed out that most of the students at these European Gymnasien and universities appeared to come from middle to upper-middle class families while the students at Jackson Community College came mostly from lower-middle to middle class families. This appeared to reflect the fact that higher education was somewhat more available in the Jackson area and desired by a wider

range of the population spectrum. The students at the engineering colleges came from the lower-middle classes; and although they were virtually all male students, they appeared to be very comparable to the socio-economic level of the male student population at Jackson Community College. Similarities between the West German Kolleg students and Jackson Community College students were very noticeable also. They were similar in socio-economic background and vocational interests. The student populations at the Technische Hochschulen and universities were virtually the same as found at the Gymnasien since they provided the only route to higher education and in fact appeared to be the sole reason for their existence.

Curriculum

Some of the most impressive characteristics of the total European physics programs included the strong commitment to physics as the most significant part of the required natural science programs. This showed up in enrollment statistics, especially at the Gymnasium level. More students were enrolled each year in physics than in biology or chemistry. This was not true in American high schools or institutions of higher education. An exception was noted at Jackson Community College. There were more students enrolled in physics each year than in chemistry, but biology had a higher enrollment than physics and chemistry combined.

At this point something must be said about the equivalency of the Gymnasium education to American education. Certainly, the Gymnasium graduates from West Germany, Austria, and Switzerland were well above the level of most American high school graduates in terms of exposure to languages, science, mathematics, social sciences, and humanities. The fact that most West German universities did not admit American transfer students to enter as first-year students until they had completed two years of American higher education did not appear to be unreasonable.

Based upon the observations and the results of the interviews, some conclusions can be drawn regarding the level of physics instruction among the various institutions in the three European countries compared to Jackson Community College. The general level of Gymnasium physics instruction was higher in Austria than in either West Germany or Switzerland when similar Gymnasium types were compared. This was not anticipated since the Austrian Gymnasium was only eight years in length compared to nine years in West Germany and eight and one-half years in Switzerland. In all three countries the science and mathematics Gymnasien had more rigorous physics programs than at the other Gymnasium types. The most sophisticated Gymnasium physics closely paralleled the College Physics sequence at Jackson Community College, which was taken

by non-science majors and had a mathematics prerequisite of trigonometry. The University Physics sequence at Jackson Community College was above the level of any Gymnasium physics encountered. This was unusual when one considered the number of years these Gymnasium students were exposed to physics. It was felt also that with the selection process that took place, the general intellectual sophistication of the Gymnasium students was higher than the University Physics students at Jackson Community College. It was felt that there was no reason why the Gymnasium students could not have progressed further except that the advanced topics were simply not in their prescribed curricula. Were these advanced topics included, it would have meant that the Gymnasium students would have been exposed to a level of physics equivalent or beyond the level of beginning physics found at the universities and Technische Hochschulen. It was felt that the Gymnasium physics programs suffered also because of the general lack of laboratory experiances.

The level of sophistication of the first-year physics programs at the universities and Technische Hochschulen was slightly below or equivalent to the level of physics presented in the University Physics at Jackson Community College. It was felt that the students were handicapped to some degree in those institutions where their physics laboratory was delayed one to two

semesters after the lecture presentations. This lack of articulation was a cause for concern to many professors and students.

The physics at the European engineering colleges, while presented in a most attractive way, did not match the level of sophistication of the University Physics at Jackson Community College and more closely paralleled the physics found in the College Physics sequence.

Many of the Gymnasium physics teachers felt that state and federal curriculum requirements kept the students from realizing their full potential in physics during the long exposure at the science and mathematics Gymnasien. The students had undergone a fairly rigorous selection process, worked extremely hard; and in six to eight years of physics classes it was felt that the students should have been able to progress far beyond the level the respective ministries of education required, or allowed, and tested.

The similarities in physics curricula among the three European countries at the Gymnasien, engineering colleges, universities, and Technische Hochschule were amazing. Differences existed only in matters of emphasis and somewhat in the physical facilities the particular economy was able to support. The similarities at the Gymnasium level that appeared most significant included the emphases on the demonstrations in the lecture classes,

the lack of physics laboratories, the small class sizes, the inflexibility of the physics offerings, the general formality of the class meetings, the fact that all of the physics was taught as though all students were majoring in the subject instead of using a general education approach, the chafing of the physics teachers because they wished to have more autonomy in the design and execution of the physics curriculum, and the restrictions placed on the teachers because they all had to teach toward one final comprehensive examination at the conclusion of the school experience. There was a decided enrollment trend away from the classical language Gymnasien to the modern language institutions, with the science and mathematics Gymnasien maintaining their same percentage of total students. In all countries a greater percentage of students were enrolling in the Gymnasien, predicting problems for the universities in years to come unless university admission policies changed.

The general environment, philosophy, and approach to teaching found at the universities of the three countries were very comparable. The physics programs seemed very professor-centered and rarely considered student needs and interests. There was some evidence that this lack of interest for the student concerns was changing. The Universities of Munich, Erlangen, and Zurich were instituting counseling programs to help students make

course and career selections. Students were being allowed to have some voice in the design of curricula. All three institutions were in the process of developing curricula for physics majors that included required courses from the areas of the social sciences and humanities. These courses were not to be included in the comprehensive testing program in the near future; so many professors had doubts regarding the effectiveness of the programs. Students were primarily responsible for instituting these new non-science requirements, and they felt that their inclusion would be welcomed as long as there was some corresponding reduction in physics and mathematics course and test requirements.

The Technische Hochschulen were different from the universities beyond the difference in vocational choices of their students. There was a more rigid attitude on the part of the physics departments and the school officials requiring attendance of students at class lectures. They usually required a heavier schedule of contact hours per week and seemed to be more successful in graduating their students in a shorter time period than the corresponding students in similar programs at the universities. An observation was made for both the universities and the Technische Hochschulen, and that was that the Herr Doktor Professors had firm control of the institutions. This was a product of tradition and

the intricacies of governmental funding of research and teaching activities controlled by the professors.

The similarities found at the engineering colleges of the three countries were significantly different from those found at the Gymnasien and the institutions of higher education. The engineering colleges were less bound by tradition and less under the domination of the teaching staffs. The institutions were much more student oriented and maintained a consistent philosophy of doing whatever was necessary to produce a desirable final product. Thus, these institutions were quite susceptible to change. This general attitude pervaded their approach to teaching, the use of aduio-visual aids, and a willingness to experiment in all phases of their program. This was true even in Austria, where the students enrolled at an earlier age than in West Germany or Switzerland; and the Austrian students were required to write the Mature the same as their Gymnasium counterparts. It was at the engineering colleges that the greatest similarities between European education and Jackson Community College were observed. The most significant characteristic shared by the physics staffs at the engineering colleges and at Jackson Community College was their commitment to attempt to satisfy community and hence student needs with their respective curricula.

One of the most significant aspects of the Jackson Community College curriculum was the many tracks of beginning physics available, five in all, that took a heterogeneous student population and attempted to provide a physics program for each of the students regardless of academic background or vocational preference. Another aspect was the firm commitment to the physics laboratory as a significant part of all five physics programs. Along with this laboratory commitment was an abundance of laboratory equipment and supplies. It was obvious that a significant financial commitment had been made for the acquisition of equipment and supplies.[1]

Evaluation

The greatest single difference in educational philosophy between the European countries and Jackson Community College was found in the attitude toward comprehensive testing. It was safe to say that even minor steps in the European educational process were documented with some type of comprehensive testing. There was no comprehensive testing at Jackson Community College. Instead it had the standard credit hour system commonly found at American institutions of higher education. Although there was some discussion at the European

universities about adding intermediate levels of testing, there was little mention of doing away with the comprehensive testing at any of the current levels.

The admission examinations at all Gymnasien did not appear to be particularly rigorous since such a high percentage of those who applied were successfully admitted. Thus, if the Gymnasien were enrolling a selected portion of the total population, this was not a result that could be credited to the testing procedures. The most significant part of the evaluation process at the Gymnasium level was the final comprehensive examination. Such examinations as the Abitur, Mature, and Matur are not commonly found in American education. The New York Regency examinations and examinations for graduates of unaccredited high schools to determine university admission are two of a very few such comprehensive examinations and are not found generally as the sole criteria for admission to higher educational institutions, although many institutions require testing as one of several criteria considered during the admission process. Rarely are these same tests used as a part of the high school completion process. The significant differences among the Abitur, Mature, and Matur were in the fewer number of subjects that were tested in West Germany compared to Austria and Switzerland. Another difference was that the Bavarian physics teachers had absolutely no part in the

preparation of the examinations, which contrasted with their Austrian and Swiss counterparts with their respective degrees of participation.

The universities and Hochschulen were committed to the Abitur, Mature, and Matur as the sole criterion for admission although many individual professors were concerned about the fact that too many students were enrolled in the Gymnasien and heading inevitably toward the universities. Many university professors felt that more than successful completion of the Abitur, Mature, or Matur would be required for university admission in the near future. In any case, growth of the universities and associated changes seemed certain. The commitment to comprehensive examinations such as the Vor-Diplom and Diplom plus the lack of individual physics course evaluations was significantly different from the situation at Jackson Community College. No individual course grades were assigned at any of the European universities and Hochschulen.

There have been some changes made in program, curriculum, and philosophy in these countries since 1969. Two examples in Bavaria are the fact that the Technische Hochschule has been renamed the Technische Universitat, and the Polytechnikum is now called the Technische Hochschule. A problem of status has been solved. Further, the Bavarian Gymnasien were scheduled to remove compulsory class attendance during years eight and nine effective in the fall of 1970. This was to provide for a smoother transition from the more rigid Gymnasien to the freer atmosphere of the University. This program was delayed, and I'm not certain whether it was put into effect during the fall of 1971.